

# A numerical approach to incorporate intrinsic material defects in micromagnetic simulations

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A number of future spintronic devices are based on the controlled movement of magnetic domain walls in thin films, disks and strips. In order to fully control this movement, it is of paramount importance to completely understand the effects of material imperfections inherently present in the magnetic samples, in nanowires in particular.

Recently it was found that the inclusion of distributed disorder in the form of voids with zero saturation magnetisation in simulations of nanowires qualitatively changes the magnetic domain wall movement [1]. In this contribution we investigate which micromagnetic parameters should be changed in micromagnetic simulations to more realistically represent material defects, i.e. to generate pinning potentials that quantitatively correspond to the measured ones [2].

In experiments the interaction range and pinning energy of natural pinning sites are accessible in contrast to the local variations of the individual micromagnetic parameters[3]. Therefore, we propose to locally reduce the exchange constant on the boundaries of clustered cells, similar to the grain boundaries of the Permalloy material. By tuning the amount with which the exchange constant is reduced and the size of the area with reduced exchange constant, the pinning strength and interaction range can be tuned to give rise to pinning potentials that correspond remarkably well with real natural defects [2].

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[1] B. Van de Wiele, et al. Phys. Rev. B 86, 144415 (2012).

[2] J. A. J. Burgess, et al. Science, 339(6123):1051–1054, 2013.

[3] R. L. Compton, et al, Phys. Rev B 81, 144412 (2010).